

1986

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Citation of this paper:

Williamson, Stephen D.. "Laissez Faire Banking and Circulating Media of Exchange." Centre for the Study of International Economic Relations Working Papers, 8624C. London, ON: Department of Economics, University of Western Ontario (1986).

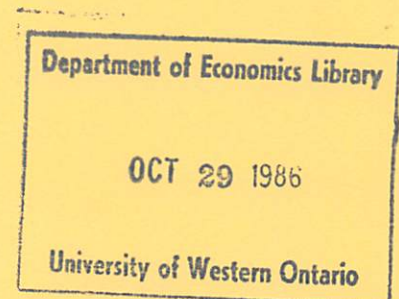
ISSN 0228-4235
ISBN 0-7714-0779-3

THE CENTRE FOR THE STUDY OF INTERNATIONAL ECONOMIC RELATIONS

WORKING PAPER NO. 8624C

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This paper contains preliminary findings from research work still in progress and should not be quoted without prior approval of the author.

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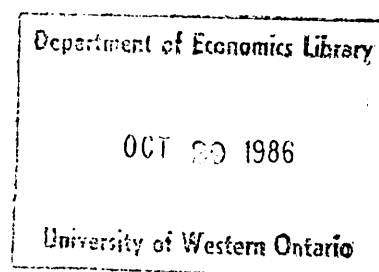
**LAISSEZ FAIRE BANKING AND
CIRCULATING MEDIA OF EXCHANGE**

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Revised October, 1986

* Thanks are due to seminar participants at the Federal Reserve Bank of Minneapolis and the University of Western Ontario. The comments and suggestions of John Boyd, Peter Howitt, and Neil Wallace were especially helpful. Financial support from the Social Sciences and Humanities Research Council of Canada is gratefully acknowledged. Any remaining errors are my own.



ABSTRACT

A model with asymmetric information and decentralized exchange is constructed, which supports conventional arguments for a government monopoly in supplying circulating media of exchange. Laissez faire banking is inherently 'unstable' and inefficient in the absence of government-supplied fiat currency. A Pareto superior outcome is possible with the introduction of fiat currency, but laissez faire is still unstable; a legal prohibition on the issue of private circulating bearer notes induces stability. The model has predictions (including rate of return dominance of circulating media of exchange) which are consistent with observations from fiat currency regimes and 'laissez faire' regimes.

I. INTRODUCTION

The view that there is a legitimate basis for a government monopoly in supplying circulating media of exchange has long been a part of conventional wisdom in monetary economics. Friedman (1960), who probably provides the most coherent reasoning to support this view, argued that (Friedman, 1960, p. 6):

"...the [private] contracts in question are peculiarly difficult to enforce and fraud particularly difficult to prevent. The very performance of its central function requires money to be generally acceptable and to pass from hand to hand...in fraud as in other activities, opportunities for profit are not likely to go unexploited."

According to Friedman, this implies that regimes with unrestricted financial intermediation are likely to be inefficient and inherently unstable, due to information externalities.

Recently, this conventional wisdom has been challenged, on both empirical and theoretical grounds. White (1984) and Rolnick and Weber (1985), in studying 19th century free banking regimes in Scotland and the U.S., argue that the evidence is inconsistent with inherent instability in laissez faire banking regimes. Rolnick and Weber (1984) and King (1983) also observe that very few bank failures during the U.S. free banking era (1837-63) were due to 'wildcat banking' (i.e. fraudulent banking practices). Hayek (1978) argues that efficiency gains would result from a move from current regimes with restricted financial intermediation to unfettered financial arrangements. In Sargent and Wallace (1982), a Pareto optimal equilibrium allocation can be achieved in a regime without restrictions on intermediation. In their model restrictions which effectively prohibit private intermediaries from issuing substitutes for fiat money imply that an equilibrium is not Pareto optimal, since different agents face different rates of return. Perhaps the best-known

recent defence of laissez faire banking is Fama (1980), where it is argued that (Fama, 1980, p. 47): "...there is nothing in the economics of this [the banking] sector that makes it a special candidate for government control".

The purpose of this paper is to construct a model in which Friedman's argument for a government monopoly in the supply of circulating media of exchange is essentially correct. We consider regimes with and without valued fiat money and with and without restrictions on private financial intermediation. The predictions of the model are consistent with what is observed in the real world counterparts of these regimes. In particular, 1) circulating media of exchange are dominated in rate of return by other assets; 2) in a laissez faire equilibrium without government-issued fiat currency, 'fraudulent' banking is nonexistent, in spite of the fact that there is a potential for such practices; 3) liabilities which can be interpreted as bank deposits coexist in equilibrium with valued fiat money or with circulating bank notes; 4) Assets yielding relatively high (low) rates of return have relatively low (high) transactions velocities.

The model we construct is one of spatially-separated 'islands' populated by overlapping generations of consumers. As in Diamond and Dybvig (1983), agents have uncertain lifetimes and preferences, features which generate a demand for liquid assets. The primitive assets in the economy are pieces of capital which can be produced only in large, indivisible, immobile quantities which are intermediated by 'banks'. Individual agents' endowments are too small for them to be able to manufacture capital on their own, and agents travel from island to island in such a way that it is physically impossible to trade primitive assets. The liabilities issued by banks under laissez faire are transferable circulating notes, and non-transferable non-circulating notes

(deposits).

In the model, capital may be either 'good' or 'bad'. Bad capital is cheaper to produce than is good capital, but it yields an inferior return. Due to environmental restrictions on the flow of information across islands, buyers and sellers of circulating bank notes are asymmetrically informed concerning the quality of capital backing a particular bank note, with the seller having better information. As a result, there is an incentive for the production of bad capital and for the issue by banks of circulating notes backed by this capital, when such an incentive would not exist without informational asymmetries.

In a regime without government-issued currency and with unrestricted private intermediation, a version of Gresham's law holds; the only stationary equilibrium which can exist is one where the only notes which circulate are those backed by bad capital. In equilibrium there is no misrepresentation of the quality of circulating bank notes. These notes coexist with non-transferable deposit liabilities backed by good capital, which dominate circulating notes in rate of return. Laissez faire banking is inherently unstable, in that a stationary equilibrium may not exist.

With the introduction of government-issued fiat currency, a stationary equilibrium with valued fiat money (monetary equilibria) may exist in which all agents are better off than in the laissez faire regime without fiat money. This occurs in spite of the fact that there exist assets which dominate fiat money in rate of return in equilibrium. These higher-yielding assets (units of good capital) are held in equilibrium as backing for bank deposits. A government monopoly in the supply of circulating media of exchange is self-enforcing if the stationary monetary equilibrium exists,

in that there is then no incentive to issue private circulating bearer notes. However, the introduction of fiat money does not make laissez faire more stable; the necessary and sufficient conditions for the non-existence of stationary equilibria are the same, whether or not fiat money is valued.

A legal prohibition on the private issue of circulating bearer notes eliminates instability. Here, a stationary monetary equilibrium always exists in which agents hold fiat money and deposit liabilities backed by assets which dominate fiat money in rate of return. No agents are worse off than with laissez faire since, if a stationary monetary equilibrium exists under laissez faire, the legal restriction is not binding.

As is consistent with Friedman (1960), legal restrictions on private financial intermediation are necessary to induce stability in our model and, in the absence of government-issued fiat currency, private banking generates an inefficient outcome. Our results differ from Friedman's reasoning in that legal restrictions are not always necessary to make a government monopoly in the supply of circulating media of exchange self-enforcing. This difference is due to the fact that Friedman treated unbacked government money and privately-issued 'money' identically, while we do not.

The remainder of the paper is organized as follows. In Section II, the model is constructed, and equilibrium under laissez faire is discussed in Section III. Section IV contains an examination of a regime with a legal prohibition on privately issued circulating notes, and the final section is a conclusion.

II. THE MODEL

This is a model of spatially-separated 'islands' populated by overlapping generations of consumers. Each period $t = 1, 2, 3, \dots, \infty$, is divided into two segments, where consumption in segment one and in segment two of a given period are perfect substitutes for all agents. At the beginning of segment one of each period, n agents are born on each of m islands, and each of these agents is endowed with y units of a good which can either be consumed or used to manufacture capital. Otherwise, the good is perishable between the first and second segments of the period.

Agents in their second period of life at the beginning of segment one of a given period learn their type, $i=1, 2$, which is private information. If an agent is type 1, she will live for two periods, with utility given by $u(c_1, c_2)$, where c_i is consumption in the i^{th} period of life. Type 2 agents live for 3 periods, with utility given by $v(c_1, c_3)$. The functions $u(\cdot, \cdot)$ and $v(\cdot, \cdot)$ are twice continuously differentiable, increasing in both arguments, and strictly concave. Let u_i and v_j denote the partial derivatives with respect to the i^{th} and j^{th} arguments of u and v , respectively. Then,

$$\lim_{\substack{c_1/c_2 \rightarrow 0}} u_1/u_2 = \infty$$

$$\lim_{\substack{c_1/c_2 \rightarrow \infty}} u_1/u_2 = 0,$$

$$\lim_{\substack{c_1/c_3 \rightarrow 0}} v_1/v_3 = \infty, \text{ and}$$

$$\lim_{\substack{c_1/c_3 \rightarrow \infty}} v_1/v_3 = 0.$$

At the beginning of segment one of each period, agents in their second and third periods of life are reallocated among islands. This reallocation occurs in such a way that no two agents receive the same island assignment more than once, and so that during segment one of each period there are n young agents, λn middle-aged agents of type 1, $(1-\lambda)n$ middle-aged agents of type 2, and $(1-\lambda)n$ old agents on each island. Here, λ is the fraction of type 1 agents in each generation, where $0 < \lambda < 1$ and λn is an integer. From each agent's point of view, at birth the probability that she is type 1 is λ . We assume that n is large, to permit competitive markets on each island, and we assume that m/n is large, so that it is feasible for any two agents not to meet more than once.

Agents are confined to their assigned island during segment one of a period, but may visit any islands during segment two of a period. We assume that particular agents are impossible to locate during segment two of any period. That is, an agent is unable at this time to locate any agent with whom a transaction was made in a previous period.

Capital manufactured in segment one of period t produces a given quantity of a non-storable consumption good in segment two of period $t+2$, at which time full depreciation occurs. Capital may be manufactured only in quantities greater than x , where $x > y$, and $x \ll ny$, and it may be of two types: 'good' and 'bad'. It requires $z(\beta z)$ units of the endowment good to manufacture z units of good (bad) capital, where $\beta < 1$. Good (bad) capital yields a return of $\alpha_1(\alpha_2)$ units of the consumption good, where $\alpha_1 > 1$ and $\alpha_2/\beta < 1$. Thus, bad capital is less costly to manufacture but yields an inferior return.

Capital is immobile, and its type is known only to the agents who were alive in the period when it was manufactured, on the island where it was manufactured. An agent can at any time verify the existence of any capital in the economy, but cannot verify its type.

In segment one of period 1, there are λn middle-aged type 1 agents, $(1-\lambda)n$ middle-aged type 2 agents, and $(1-\lambda)n$ old agents on each island, each of whom is endowed with H units of fiat money, i.e. unbacked, perfectly divisible, non-counterfeitable notes issued by the government. Middle-aged type 1 agents and old agents supply fiat money inelastically at time 1 so as to maximize period 1 consumption, while middle-aged type 2 agents maximize period 2 consumption by selling their money endowment at that date.

In this environment, intermediation in some form is necessary for capital formation, due to the fact that capital is immobile and cannot be manufactured by any one agent. The spatial separation of agents on different islands through their lifetimes serves to make some types of trades impossible, but this friction matters for different reasons than in some of Townsend's models (for example, see Townsend, 1980, 1983).¹ Here, spatial separation implies that a given agent on a given island cannot trade with any other agent who knows the type of capital which backs the securities she holds. Thus, there is potentially an adverse selection problem in this environment. Trading can only occur during segment one of a period, when agents are confined to a single assigned island. However, since agents can visit any island in segment two of a period, it will be possible for a particular agent to collect the payoffs on any securities which she might acquire.

As in Diamond and Dybvig (1983), agents' random preferences imply that each agent's future requirement for 'liquid' assets is uncertain. This

permits a richer array of potential equilibria and phenomena of interest than if agents were all three-period-lived as, for example, in Freeman (1985).

Trading

So that capital formation can take place, 'banks' arise which issue securities in exchange for the endowment good, manufacture capital, and redeem securities two periods in the future. Banks are owned by shareholders who each receive a fraction of a bank's profits equal to the fraction of shares held. This environment generates the same equilibrium outcomes as one where 'firms' borrow from banks to manufacture capital and banks act only as intermediaries. 'Good' ('bad') banks use the pooled endowment good to manufacture good (bad) capital, and issue good (bad) bank notes. Agents will be able to verify whether there is capital backing a given note and to verify its age, but they will not know the type of this capital unless they were at the bank's location when the capital was manufactured.

All notes are perfectly divisible, and there are four types of notes; good and bad bearer notes which may circulate, and good and bad non-transferable notes which do not circulate.² To normalize, we let one newly-issued good bearer note trade at time t for one unit of the endowment good. Competition among banks and free entry into banking then implies that this note can be redeemed at time $t+2$ for α_1 units of the consumption good. One newly-issued bad bearer note can be acquired for β units of the endowment good at time t , and redeemed for α_2 units of the consumption good at time $t+2$. Agents who learn they are type 1 will not be able to redeem their non-transferable notes. Since λn of the young agents on each island will be type 1, and since n is large, each bank can issue non-transferable notes to

large numbers of noteholders and guarantee an essentially certain redemption value. Since bad non-transferable notes offer an inferior return, only good non-transferable notes will be issued in equilibrium, with a guaranteed two-period gross rate of return of $\alpha_1/(1-\lambda)$. With banks earning zero profits in equilibrium, the price of bank shares will be zero, and bank shares can be dropped from the analysis.

Non-transferable notes can be interpreted as bank deposits. As is the case for real world bank deposits, they are non-circulating claims which cannot finance some types of consumption. Circulating bearer notes can be used to finance consumption at redemption or in the preceding period, provided other agents will accept these notes. Thus, unlike non-transferable notes, they have the potential for financing second period consumption for a type 1 agent. Fiat money may be acquired at any date to finance consumption at any later date, provided that it is valued.

III. EQUILIBRIUM

We confine attention to equilibria where prices are identical across islands, so that we need to examine only the behavior of individuals of each type on a representative island. Let p_t denote the price of fiat money in terms of the consumption good at time t , and let q_t denote the price of bearer notes issued in period $t-1$ (secondhand bearer notes). Also, let γ_t be the fraction of secondhand bearer notes traded in period t which are good. Note that good and bad secondhand bearer notes will be indistinguishable to the buyers of these notes where they are traded. If an agent chooses to acquire secondhand notes at any time, due to risk aversion she will diversify over notes issued by a large number of banks, thus receiving the mean

return on secondhand notes.

The one-period gross rates of return to holding newly-issued good bearer notes, newly-issued bad bearer notes, secondhand bearer notes, and fiat money are, respectively, q_{t+1} , q_{t+1}/β , $[\gamma_t \alpha_1 + (1-\gamma_t) \alpha_2]/q_t$, and p_{t+1}/p_t . Therefore, if $q_{t+1} > 0$, the one-period holding return at time t for a newly-issued bad bearer note is greater than for a newly-issued good bearer note. Newly-issued good bearer notes will then not be acquired by type 2 agents in their second period of life in equilibrium, and secondhand good bearer notes will not be sold by type 2 agents in their second period of life.

The gross rates of return to holding a non-transferable note, a newly-issued good bearer note, and a newly-issued bad bearer note from period t to period $t+2$ are, respectively, $\alpha_1/(1-\lambda)$, α_1 , and α_2/β . Therefore, if $q_{t+1} = 0$, then bearer notes will not be issued at time t , since $\alpha_1/(1-\lambda) > \alpha_1 > \alpha_2/\beta$. If $q_{t+1} > 0$, then all newly-issued bad bearer notes acquired at time t will be sold at time $t+1$, since the gross rate of return to acquiring newly-issued bad bearer notes at time t , selling them at time $t+1$, and acquiring secondhand bearer notes is $[\gamma_{t+1} \alpha_1 + (1-\gamma_{t+1}) \alpha_2]/\beta \geq \alpha_2 \cdot \beta$.³

An agent who is young at time t then chooses nominal fiat money balances, m_t^t and m_{t+1}^t , non-transferable notes f_t , secondhand bearer notes s_t^t and s_{t+1}^t , newly-issued good bearer notes, g_t , and newly-issued bad bearer notes b_t^t and b_{t+1}^t to solve the following, where subscripts on asset quantities refer to the time assets are acquired, and superscripts denote the date at which the agent was born.

$$\max \lambda u(c_t^t, c_{t+1}^t) + (1-\lambda)v(c_t^t, c_{t+2}^t) \quad (1)$$

subject to:

$$c_t^t = y - p_t^m m_t^t - f_t^t - q_t^s s_t^t - g_t^t - \beta b_t^t. \quad (2)$$

$$c_{t+1}^t = p_{t+1}^m m_t^t + [\gamma \alpha_{t+1} + (1-\gamma) \alpha_t] s_t^t + q_{t+1}^s (g_t^t + b_t^t) \quad (3)$$

$$c_{t+2}^t = p_{t+2}^m m_{t+1}^t + \alpha f_t^t / (1-\lambda) + [\gamma \alpha_{t+1} + (1-\gamma) \alpha_{t+1}] s_{t+1}^t + \alpha g_{t+1}^t + q_{t+2}^s b_{t+1}^t \quad (4)$$

$$p_{t+1}^m m_{t+1}^t + q_{t+1}^s s_{t+1}^t + \beta b_{t+1}^t = p_{t+1}^m m_t^t + [\gamma \alpha_{t+1} + (1-\gamma) \alpha_t] s_t^t + q_{t+1}^s b_t^t, \quad (5)$$

$$c_t^t, c_{t+1}^t, c_{t+2}^t, m_t^t, m_{t+1}^t, s_t^t, s_{t+1}^t, g_t^t, f_t^t, b_t^t, b_{t+1}^t \geq 0. \quad (6)$$

In (1) - (6), c_t^z denotes consumption at time t of an agent born at time z .

Middle-aged type 1 agents sell all assets acquired in the first period of life, in order to maximize c_{t+1}^t , while middle-aged type 2 agents retain the newly-issued good bearer notes and non-transferable notes acquired in the first period of life, selling all other assets to acquire new assets to carry into period $t+2$, when all assets are sold to finance old age consumption.

Definition 1. An equilibrium is a nonnegative infinite sequence of prices

$\{\bar{p}_t, \bar{q}_t\}$, a sequence of asset quantities $\{\bar{a}_t\} = \{\bar{m}_t, \bar{m}_{t+1}, \bar{s}_t, \bar{s}_{t+1}, \bar{b}_t\}$,

$\{\bar{b}_{t+1}, \bar{g}_t, \bar{f}_t\}$, a sequence of consumption quantities $\{\bar{c}_t\} = \{\bar{c}_t^t, \bar{c}_{t+1}^t\}$,

$\{\bar{c}_{t+2}^t\}$, and a sequence of γ 's, $\{\bar{\gamma}_t\}$, such that

(i) $\{\bar{c}_t\}$ and $\{\bar{a}_t\}$ are chosen to solve (1) subject to (2) - (6),

given $\{p_t, q_t\} = \{\bar{p}_t, \bar{q}_t\}$ and $\{\gamma_t\} = \{\bar{\gamma}_t\}$.

(ii) The money market clears.

$$\bar{p}_t [\bar{m}_t + (1-\lambda)\bar{m}_t^{t-1}] = \bar{p}_t (2-\lambda)H, \quad t=2,3,\dots,\infty \quad (7)$$

$$\bar{p}_1 \bar{m}_1 = \bar{p}_1 H \quad (8)$$

(iii) The market for secondhand bearer notes clears.

$$\bar{s}_t^{t-1} + (1-\lambda)\bar{s}_t^{t-1} = \lambda \bar{g}_{t-1}^{t-1} + \bar{b}_{t-1}^{t-1} + (1-\lambda)\bar{b}_{t-1}^{t-2}, \quad t=3,4,\dots,\infty \quad (9)$$

$$\bar{s}_2^{t-2} + (1-\lambda)\bar{s}_2^{t-1} = \lambda \bar{g}_1^{t-1} + \bar{b}_1^{t-1} \quad (10)$$

$$\bar{s}_1^{t-1} = 0 \quad (11)$$

(iv) The sequence of γ 's is correctly anticipated. That is, if any

one of \bar{g}_{t-1}^{t-1} , \bar{b}_{t-1}^{t-1} or \bar{b}_{t-1}^{t-2} is positive, then

$$\bar{\gamma}_t = \bar{\lambda} \bar{g}_{t-1}^{t-1} / [\bar{\lambda} \bar{g}_{t-1}^{t-1} + \bar{b}_{t-1}^{t-1} + (1-\lambda)\bar{b}_{t-1}^{t-2}], \quad t = 3,4,5,\dots,\infty, \quad (12)$$

and

$$\bar{\gamma}_2 = \bar{\lambda} \bar{g}_1^{t-1} / [\bar{\lambda} \bar{g}_1^{t-1} + \bar{b}_1^{t-1}], \quad t=2. \quad (13)$$

Otherwise

$$\bar{\gamma}_t = \min\{(\beta p_{t+1}/p_{t-1} - \alpha_2)/(\alpha_1 - \alpha_2), 1\}. \quad (14)$$

This is a perfect foresight equilibrium where agents correctly anticipate prices and the fraction of good bearer notes sold on the secondhand market in each period. However, matters are not entirely straightforward if no secondhand notes are traded in any period, t . Then, the characteristics

of an equilibrium depend in part on the conjectures agents make concerning γ_t . Equation (14) states that, if no private bearer notes are issued at time $t-1$ (implying a supply of zero secondhand notes at time t), then the conjecture agents make concerning γ_t must be consistent with what is observed in equilibrium. To see why (14) makes sense, note first that any equilibrium where secondhand bearer notes are not traded at some time t is a monetary equilibrium (i.e. $p_t > 0$ for all t) with $p_{t+2}/p_t \geq \alpha_2/\beta$ for all t . If secondhand bearer notes are not traded at time t , then agents anticipate that if these notes were traded, they would be perfect substitutes for fiat money. As will be shown, if any bearer notes are issued in equilibrium at time t , then bad bearer notes are issued at time t . We therefore have

$$q_t = \beta p_t / p_{t-1} \quad (15)$$

and

$$[\gamma_t \alpha_1 + (1-\gamma_t) \alpha_2] / q_t = p_{t+1} / p_t. \quad (16)$$

Provided that $p_{t+1}/p_{t-1} \leq \alpha_1/\beta$, and given that $p_{t+1}/p_{t-1} \geq \alpha_2/\beta$, the value of γ_t which solves (15) and (16) is in the interval $[0,1]$. In the case where $p_{t+1}/p_{t-1} > \alpha_1/\beta$, agents conjecture that $\gamma_t = 1$, and we obtain (14).

Define r_t , the maximum one-period gross rate of return at time t , by

$$r_t \equiv \max\{p_{t+1}/p_t, q_{t+1}/\beta, [\gamma_t \alpha_1 + (1-\gamma_t) \alpha_2] / q_t\}. \quad (17)$$

Then, from (1) - (5) and the Kuhn-Tucker conditions, we have

$$-\lambda u_1 - (1-\lambda) v_1 + \lambda q_{t+1} u_2 + (1-\lambda) \alpha_1 v_2 \leq 0 \quad (18)$$

$$-\lambda u_1 - (1-\lambda)v_1 + \lambda r_t u_2 + (1-\lambda)r_t r_{t+1} v_2 \leq 0 \quad (19)$$

$$-\lambda u_1 - (1-\lambda)v_1 + \alpha_1 v_2 \leq 0. \quad (20)$$

To rule out certain types of equilibria,⁴ we make the following three assumptions:

$$u_2 \left| c_1 = x, c_2 = y \right. + y u_{22} \left| c_1 = x, c_2 = y \right. \geq 0, \quad (21)$$

$$v_2 \left| c_1 = x, c_3 = y \right. + y v_{22} \left| c_1 = x, c_3 = y \right. \geq 0, \quad (22)$$

and

$$\alpha_1 v_2 \left| c_1 = x, c_3 = \alpha_1 y \right. \geq \alpha_1^{1/2} u_2 \left| c_1 = x, c_2 = \alpha_1^{1/2} y \right. , \quad (23)$$

for all $x, y > 0$.

If utility is additively time-separable, then (21) and (22) imply that the coefficient of relative risk aversion of the period utility function is less than or equal to unity. If $u(c_1, c_2) = c_1^a + \delta c_2^a$ and $v(c_1, c_3) = c_1^a + \delta^2 c_3^a$, with $0 < a < 1$ and $0 < \delta < 1$, then (20) implies that $\alpha_1^{a/2} \geq 1/\delta$.

Before studying the properties of particular equilibria in the model, we can state the following.

Proposition 1: If good bearer notes are issued in any period t in equilibrium, then bad bearer notes are also issued at time t .

Proof: Suppose that good bearer notes are issued in equilibrium at time t , but bad bearer notes are not. Then, the two-period gross rate of return to

acquiring newly-issued bad bearer notes at time t , selling them at time $t+1$, and using the proceeds to acquire secondhand notes which are redeemed at time $t+2$, is $\alpha_1/\beta > \alpha_1$. Also, the one-period return to acquiring newly-issued bad bearer notes at time t is $q_{t+1}/\beta > q_{t+1}$, the one-period return to acquiring newly-issued good bearer notes. There are then unexploited profit opportunities in equilibrium, a contradiction. Q.E.D.

We restrict attention in the remainder of the paper to stationary equilibria, defined as follows.

Definition 2: A stationary equilibrium is an equilibrium in which $(c_t^t, c_{t+1}^t, c_{t+2}^t) = (c_1, c_2, c_3)$, $q_t = q$, and $p_t = p$ for all t , where c_i , p and q are nonnegative constants.

Non-Monetary Equilibrium

In this section, we examine stationary equilibria where fiat money is not valued; i.e. $p_t = 0$ for all t . Equivalently, the initial old and middle-aged receive endowments of zero units of fiat money (fiat money is absent).

We first need some notation for characterizing equilibria. Let A denote the set of assets which are held in a stationary equilibrium, where $A \subset \{G, B, F\}$. If $G \in A$, then good bearer notes are held in equilibrium; if $B \in A$, then bad bearer notes are held; if $F \in A$, then non-transferable notes are held. Given proposition 1, the only possibilities in a stationary non-monetary equilibrium are the following.

Case 1. $A = \{G, B, F\}$

Case 2. $A = \{B\}$

Case 3. $A = \{F\}$

Case 4. $A = \{G, B\}$

Case 5. $A = \{B, F\}$

We will proceed to show that case 5 is the only possibility.

First, we cannot have case 3 in equilibrium, since this implies that $q=0$. If this were the case, then for any $\gamma \in [0,1]$, the one-period return from holding secondhand bearer notes would be infinite, and therefore this cannot be an equilibrium. If we have case 1, then (18) - (20) must each hold with equality, but this is only possible if

$$-\alpha_1 q_{t+1} + (1-\lambda)r_t r_{t+1} q_{t+1} + \lambda \alpha_1 r_t = 0 \quad (24)$$

for all t . If (24) holds, then it must be the case that either no good bearer notes are held, no bad bearer notes are held, or no non-transferable notes are held. But this is a contradiction, so case 1 is not a possibility. For the remaining cases, 2, 4, and 5, bad bearer notes are held. Therefore, we must have

$$r_t = q/\beta \quad (25)$$

for all t . If good bearer notes are held, as in case 4, then we must have $r_t r_{t+1} < \alpha_1$ or, given (25),

$$q < \beta \alpha_1^{\frac{1}{2}}. \quad (26)$$

Case 4 also implies, given that (18) and (19) must hold with equality, and (20) with a weak inequality, that

$$-\alpha_1 \beta^2 + (1-\lambda)q^2 + \lambda \alpha_1 \beta \leq 0. \quad (27)$$

But (26), (27) and (18) - (23) then imply that (18) and (19) cannot both hold with equality. Therefore, we can rule out case 4. Case 2 can be eliminated from consideration, as this implies that (19) holds with equality and (18) and (20) are weak inequalities. But then, (21) - (23) imply that (20) does not hold. This leaves case 5, where

$$q = (\alpha_2 \beta)^{\frac{1}{2}} \quad (28)$$

Proposition 2. A unique stationary non-monetary equilibrium exists if and only if

$$\alpha_1(\beta - \gamma) - \alpha_2(1 - \lambda) \leq 0 \quad (29)$$

Proof: Necessity. In a case 5 equilibrium, (19) and (20) must hold with equality. But (24) and (28) then imply that (18) holds if and only if (29) holds.

Sufficiency. Suppose that (29) holds. Then, since $u(\cdot, \cdot)$ and $v(\cdot, \cdot)$ are concave, there is a unique $w > 0$ and a unique $f > 0$ such that, with

$c_1 = y - f - w$, $c_2 = w(\alpha_2/\beta)^{\frac{1}{2}}$, $c_3 = \alpha_1 f/(1-\lambda) + (\alpha_2/\beta)w$, agents facing

prices $p_t = 0$ and $q_t = (\alpha_2 \beta)^{1/2}$ for all t choose: $c_t^t = c_1$, $c_{t+1}^t = c_2$, $c_{t+2}^t = c_3$ and $f_t = f$ for all t . Here, w is the quantity of savings by each young agent in the form of newly-issued bad bearer notes and secondhand bearer notes. The number of bad bearer notes issued in period t (per capita) is k_t , where

$$k_1 = \beta w$$

and

$$k_t = \beta w [1 - \lambda \sum_{i=2}^t \theta^{i-1} (-1)^i], \quad t=2, 3, \dots, \infty,$$

with $\theta = (\alpha_2 / \beta) < 1$. Therefore, $k_t > 0$ for all t , and

$$\lim_{t \rightarrow \infty} k_t = \beta w [1 - \lambda \theta / (1 - \theta)].$$

Therefore, this is a stationary nonmonetary equilibrium and, given the uniqueness of f and w , it is unique.

Q.E.D.

Note, in spite of the fact that consumption allocations and prices are stationary in the stationary non-monetary equilibrium, that the number of bearer notes issued in each period, k_t , is not a constant. However, k_t converges over time to a steady state.

In the absence of fiat money, or if fiat money is not valued, the only stationary equilibrium which exists is one where a version of Gresham's law holds; the private bearer notes which circulate are those backed by bad capital, in spite of the fact that higher-yielding assets are available. Bank deposits (non-transferable notes) are also held in equilibrium, and the assets backing these notes dominate the assets backing circulating notes in rate

of return. The transactions velocity of circulating notes is higher than for bank deposits, since the entire stock of circulating notes turns over each period.

Note, in spite of the fact that the potential for 'fraudulent' banking exists in this environment and is important for generating the results, that there is no fraud in a non-monetary equilibrium. All circulating bearer notes are recognized as being backed by bad capital, and neither banks or noteholders can credibly claim otherwise. This is consistent with Rolnick and Weber's (1984, 1985) interpretation of the evidence from the U.S. free banking era, that banking fraud was insignificant. However, note that the potential for fraud is an important feature of our model and that this results in an inefficiency, at least relative to an environment with full information. That is, if capital type were publicly observable, then no bad capital would be produced. Since bad capital is produced in a stationary non-monetary equilibrium, the equilibrium allocation is inefficient.

Private banking is 'unstable' under laissez faire in that a stationary non-monetary equilibrium does not exist if (29) does not hold. This instability is a direct result of the incentive which exists for banks to issue bad bank notes. Our interpretation of instability is similar to that of Smith (1984), who constructs a model of deposit banking where the instability of an unregulated banking system is reflected in the non-existence of equilibrium under some circumstances.

MONETARY EQUILIBRIUM

In this section we will restrict attention to stationary monetary equilibria, where $p_t = p > 0$ for all t . We therefore have

$$r_t = 1 \quad (30)$$

for all t . The following proposition is useful in further confining the search for monetary equilibria.

Proposition 3: In a stationary monetary equilibrium, if it exists, either good bearer notes are issued or no bearer notes are issued.

Proof: Suppose that bad bearer notes are issued in a stationary monetary equilibrium, but good bearer notes are not. Then, given (30), the one-period return to acquiring a secondhand bearer note must be unity, or $q_t = \beta$, and the one-period return to acquiring a newly-issued bearer note must also be unity, or $q_t = \alpha_2$. But this is a contradiction, since $\alpha_2/\beta < 1$. Q.E.D.

Proposition 1 and proposition 3 then imply that in a stationary monetary equilibrium either bearer notes are not issued or good bearer notes and bad bearer notes coexist with valued fiat money. We then have one of the following cases, where A is now the set of assets held in a stationary equilibrium in addition to fiat money.

Case 1. $A = \{G, B, F\}$

Case 2. $A = \{F\}$

Case 3. $A = \{G, B\}$

Case 4. $A = \{ \}$

Case 1 can be ruled out through reasoning identical to that for the stationary non-monetary equilibrium. With case 3 we must have

$$q_t = \beta \quad (31)$$

and

$$\gamma_t = (\beta - \alpha_2) / (\alpha_1 - \alpha_2). \quad (32)$$

Equations (31) and (32) state that newly-issued bad bearer notes and secondhand bearer notes are perfect substitutes for fiat money in equilibrium given (30). With case 3, (18) and (19) must hold with equality, but this is inconsistent with (21) - (23). With case 4, (19) holds with equality, but this implies that (20) does not hold. Therefore, the only possibility is case 2.

Proposition 4. A unique stationary monetary equilibrium exists if and only if (29) holds.

Proof: Necessity: From definition 1, in the case 2 equilibrium q_t and γ_t are given by (31) and (32). Given this, (18) will not hold in equilibrium if (29) does not hold. I.e., if (29) does not hold, there is an incentive for banks to issue good bearer notes given equilibrium prices, and therefore an equilibrium does not exist.

Sufficiency: Since $u(\cdot, \cdot)$ and $v(\cdot, \cdot)$ are concave, there is a unique (s^*, f^*) with $s^*, f^* > 0$ which is the solution to:

$$\max_{(s, f)} \lambda u(y - s - f, s) + (1 - \lambda) v(y - s - f, s + \alpha_1 f / (1 - \lambda)) \quad (33)$$

Then, if agents face prices of $q_t = \beta$, $p_t = (2-\lambda)s^*/H$, and $\gamma_t = (\beta-\alpha_2)/(\alpha_1-\alpha_2)$ for all t , and if (29) holds, then it is optimal for agents to choose $m_t^t = m_{t+1}^t = s^*/p_t$ and $f_t = f^*$ for all t . The market for fiat money clears in each period and the market for secondhand notes clears (with quantity demanded and supplied equal to zero in each period). Q.E.D.

Next, we state and prove the following welfare result.

Proposition 5. Under laissez faire, if a stationary non-monetary equilibrium exists, then a stationary monetary equilibrium exists which is Pareto superior.

Proof: Propositions 2 and 4 imply that the stationary monetary equilibrium exists if and only if the stationary non-monetary equilibrium exists. Agents in the proposition 4 equilibrium face a gross rate of return of unity to holding assets for one period, while agents in the proposition 2 equilibrium face a one-period gross rate of return of $(\alpha_2/\beta)^{1/2} < 1$. Agents in both equilibria also have the option of holding non-transferable notes with a two period gross rate of return of $\alpha_1/(1-\lambda)$. Therefore, agents born in period $t = 1, 2, 3, \dots, \infty$, are unambiguously better off in the proposition 4 equilibrium. Also, agents who are in their second and third periods of life at time 1 are better off in the proposition 4 equilibrium, since their endowments of fiat money are not valued in the non-monetary equilibrium. Q.E.D.

Introducing government-produced fiat money permits the existence of an equilibrium with valued fiat money in which all agents are better off than in the stationary non-monetary equilibrium under laissez faire. Note that

the government has an effective monopoly on the issue of circulating notes in a stationary monetary equilibrium. This monopoly is self-enforcing in that would-be private note issuers have no incentive to issue either good or bad bearer notes in equilibrium. Note that valued fiat money coexists in the stationary monetary equilibrium with private deposit liabilities. The assets which back deposits (good capital) dominate fiat money in rate of return, and fiat money has a higher transactions velocity than do deposits.

Note, however, that the mere introduction of fiat money does not remove or lessen the problem of instability. From propositions 2 and 4, under laissez faire the stationary monetary equilibrium does not exist if and only if the stationary non-monetary equilibrium does not exist. Introducing fiat money does not change the subset of the parameter space in which we have non-existence of a stationary equilibrium.

IV. RESTRICTIONS IN PRIVATE BANKING

The reason that a stationary monetary equilibria may not exist under laissez faire is that the government's monopoly in the supply of circulating media of exchange is not always self-enforcing. If (29) does not hold, then there exists an incentive for private banks to issue good bearer notes in a stationary monetary equilibrium. Given that good bearer notes are issued, there are profit opportunities to issuing bad bearer notes, and the equilibrium unravels.

This suggests that 'stability' could be achieved through legal restrictions on private banking. In most (if not all) regimes with government-issued fiat money, there are restrictions on the types of liabilities which private intermediaries may issue. A common restriction

is the prohibition of at least some types of circulating notes. Suppose, then, that we introduce a prohibition on the issue of circulating notes by private intermediaries in the model of Section II. Each young agent born at time t then chooses nominal fiat money acquisitions, m_t , and nontransferable note acquisitions, f_t , to solve:

$$\max \lambda u(c_t^t, c_{t+1}^t) + (1-\lambda)v(c_t^t, c_{t+2}^t)$$

$$\text{subject to: } c_t^t = y - p_t m_t - f_t$$

$$c_{t+1}^t = p_{t+1} m_t$$

$$c_{t+2}^t = p_{t+2} m_t + \alpha_1 f_t / (1-\lambda)$$

$$c_t^t, c_{t+1}^t, c_{t+2}^t, m_t, f_t \geq 0.$$

The first order conditions for an optimum are then

$$-\lambda u_1 - (1-\lambda)v_1 + \lambda p_{t+1} u_2 / p_t + (1-\lambda)p_{t+2} v_2 / p_t = 0, \quad (34)$$

$$-\lambda u_1 - (1-\lambda)v_1 + \alpha_1 v_2 \leq 0, \quad (35)$$

where (35) holds with equality if $f_t > 0$.

It is immediate from proposition 4 that, with a legal prohibition on the private issue of circulating bearer notes, a stationary monetary equilibrium always exists. If (29) holds, the equilibrium is identical to the stationary monetary equilibrium under laissez faire, since the legal restriction is not binding. If (29) does not hold, the legal restriction is binding, and the equilibrium is of the same type; valued fiat money with a gross rate of return

of unity coexists with deposit liabilities backed by good capital.

Thus, legal restrictions can eliminate the problem of instability in laissez faire banking, without making any agents worse off. This can be contrasted to Sargent and Wallace (1982), where restrictions on private intermediation make some agents better off and some agents worse off, and where a Pareto optimal equilibrium always exists under laissez faire. In Smith (1986), the existence of fiat money permits the existence of equilibrium in an environment with adverse selection, but legal restrictions do not have a role in permitting the existence of equilibrium.

CONCLUSIONS

The model constructed here confirms the conventional wisdom of Friedman (1960); due to informational externalities, laissez faire banking tends to be unstable, and it can be inefficient. Establishing a government monopoly in the supply of circulating media of exchange can improve matters. However, our results differ from the views of Friedman in that a government monopoly in supplying circulating notes is self-enforcing in some circumstances, without restrictions on the activities of private intermediaries. The most important reason for this difference is that Friedman did not draw a distinction between unbacked fiat money and privately-issued 'money'.

The primary feature of the model which generates these results is the decentralized nature of exchange. Since exchange occurs at times and in places where it is costly for agents who engage in trade to verify the quality of financial claims which are offered in exchange for goods, there are advantages to having a universally-recognizable medium of exchange. Our model captures this type of costly communication and decentralized exchange, as do some models of Townsend (see Townsend 1980, 1983), in an environment with

spatial separation, where trade and communication across 'islands' is infinitely costly. Clearly, as communication becomes less costly in the real world with advances in technology, the gain from having a government monopoly in the provision of media of exchange will diminish. However, it is unlikely that exchange technologies have advanced to the point where laissez faire banking would be preferable.

What is not studied in this paper is the possibility that the government might misuse its power to extract seignorage, once private circulating notes are prohibited, and thus inflict costs on the private sector through anticipated and unanticipated inflation. These costs are emphasized in Friedman's more recent writings. Friedman and Schwartz (1986, p. 59) even go so far as to argue that "leaving monetary and banking arrangements to the market would have produced a more satisfactory outcome [over the last quarter century] than was actually achieved through government involvement." Perhaps binding restrictions on government behavior are needed in regimes with fiat currency to generate preferred outcomes. However, this is a topic for further research.

Another issue which is not studied in the regime with restricted private intermediation is the optimal management of the stock of fiat money by a benevolent government. Putting aside the issue of how the government is to tax and make transfers with spatial separation, we might ask whether standard 'optimal quantity of money' prescriptions apply here. Since this model has some features which are common to Freeman (1985) and Woodford (1983), where the welfare effects of inflation are studied, we might arrive at similar conclusions to those of either or both of these authors, though this is only a conjecture.

FOOTNOTES

¹At least this is the case in the equilibria studied in this paper, where prices are identical across islands in each period.

²This set of securities exhausts the possibilities for trading, given the nature of the informational and trading restrictions implied by the environment. Other institutional arrangements, such as having banks which live more than 3 periods and issue deposits subject to withdrawal at any time, would be equivalent to this one.

³We assume that if an agent is indifferent between selling asset a to buy asset b, and holding asset a, that the agent chooses the first option.

⁴As will be shown in what follows, (21), (22), and (23) guarantee that non-transferable notes (deposits) are held in all stationary equilibria, and that stationary equilibria where good and bad bearer notes are issued do not exist. Note that (21) - (23) are sufficient but not necessary for these results.

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